Supercomputer Automotive Applications Partnership

'he Supercomputer Automotive Applications Partnership
SCAAP) is the 12th major R&D consortium formed
ınder the auspices of the U.S. Council for Automotive
Research (USCAR). Through collaboration, Argonne;
our other DOE national laboratories (Los Alamos,
.awrence-Livermore, Oak Ridge, and Sandia); and
GM, Ford, and Chrysler are developing high-performance
omputer systems that will "leapfrog" the technology
utomakers now use.

Argonne's involvement in the partnership is focused on
omputational fluid dynamics and composite material
nodeling. For example, researchers are using a new-
eneration fluid dynamics code and virtual reality to
tudy heating, ventilation, and air-conditioning systems
or automobiles. The computer program, called CHAD
Computational Hydrodynamics for Advanced Design),
nodels air flow in the passenger compartment of an
utomobile. Researchers can view the
esults of the CHAD calculations
n three dimensions in
Argonne's CAVE.

'hrough composite-materials modeling, partnership
ngineers are developing efficient computational
nodels of lightweight fiberglass composites, which
utomakers can use to design and manufacture lighter,
afer vehicles economically — and without increasing

ARGONNE NATIONAL LABORATORY

Argonne National Laboratory is committed to research and development leading to high-quality, cost-effective products that meet the nation's goals of improving energy efficiency, reducing emissions, and manufacturing affordable, advanced-technology vehicles.

The Laboratory has forged partnerships with many firms in the energy and transportation sectors over the past two decades. Our location, right in the nation's heartland and industrial center, makes cooperative research accessible and cost-effective.

Argonne's innovative research in advanced computing is helping to provide solutions to the challenges of creating a new generation of vehicles. These programs are supported by the Department of Energy and U.S. industry.

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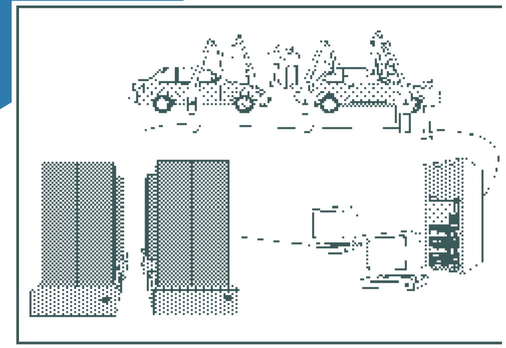
ADVANCED COMPUTING
Automotive Applications



Modeling Complex Vehicle Components, Manufacturing Processes, and Systems

Improving Vehicle Design and Safety

Working in Partnership with Industry

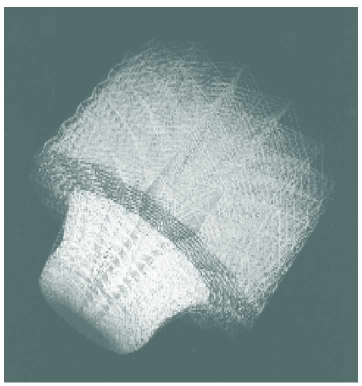
Argonne's comprehensive computer models offer complementary approaches to empirical testing in the design process. Many of Argonne's codes are directly applicable to the problems facing automobile manufacturers.

ARGONNE NATIONAL LABORATORY

Computational Fluid Dynamics for Automotive Applications

imulating Combustion Processes with KIVA

rgonne scientists are using KIVA-3, a combustion code sed worldwide, for the numerical calculation of transient hree-dimensional chemically reactive fluid flows with prays. Researchers can visualize the results of KIVA-3 alculations in Argonne's immersive Cave Automatic irtual Environment (CAVE), an advanced virtual reality nvironment that allows them to understand the impact f design changes on the combustion process.



Piston KIVA-3

sing LEVITATE to Model uel-Injection and Exhaust Systems

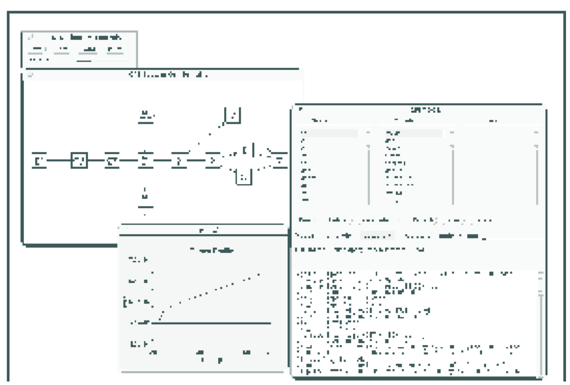
or several years, Argonne scientists have used EVITATE, a multiphase, multicomponent code, to nalyze the transient behavior of complicated thermal- ydraulic systems involving multicomponent flow with hase changes (solid, liquid, or gas). Automakers are onsidering the use of codes like LEVITATE to model

Simulating Cooling Systems with COMMIX to Improve Auto Components

Argonne has developed the COMMIX family of codes, a series of three-dimensional, transient analysis tools that can be used to predict temperature, velocity, pressure, and phase distribution in an integrated group of coupled components. Engineers can use COMMIX and COMMIX-related codes to study vehicle aerodynamics and under-hood cooling, as well as heating, ventilation, and air conditioning.

Modeling Complex Manufacturing Processes

The General Purpose Simulator (GPS), developed by Argonne for the U.S. Department of Energy (DOE), the Air Force, and NASA, is used to design and analyze advanced power and propulsion systems. It provides a framework for modeling complex systems, which can be represented as arbitrary configurations of component models interconnected by logical or physical flows. With the GPS, engineers and designers can fully explore design trade-offs and operating strategies and design better manufacturing processes and systems.



Computational Mechanics for Automotive Applications

Substituting Simulations for Car Crashes to Improve Automobile Design and Driver Safety

Argonne is at the forefront of high-performance computing, which, through large-scale computer simulations visualized in Argonne's CAVE, is minimizing the costly construction of prototypes and the experimental verification of product designs. Argonne researchers perform distributed and massively parallel processing through individual or network-connected workstations, multiprocessors with and without shared memory, and innovative combinations of both.

Argonne researchers are also developing computational mechanics software for use on parallel computing platforms. Their goal: to significantly reduce computing time for simulating the response of full vehicles and their components, such as a collapsible steering column, to crashes.

Optimizing Automotive Design with Interactive Computing

With interactive computer graphics, engineers can contro a simulation while the computation proceeds on a high-performance computer. Argonne engineers can, for example, redesign an automobile structural rail — a key energy-absorbing component of the frame — by introduc ing lighter materials at noncritical sections. Their goal is to create an optimal design in terms of weight, cost, safety, and manufacturing ease. This technique is both efficient and cost-effective, because engineers can check the progress of a simulation, terminate work on unfruitful